PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

I hereby certify that this correspondence is being deposited with the U.S. Postal Service as first class mail in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on January 11, 2006.

Appl No.	: 09/729,443	Confirmation No. 6265
Applicant	: Steven Jaffe, et al.	
Filed	: December 4, 2000	
Title	: VITERBI SLICER FOR TURBO CODES	

TC/A.U.   : 2631
Examiner   : Juan A. Torres

Docket No.   : 36928/B600
Customer No. : 23363

DECLARATION UNDER 37 CFR §1.131

Commissioner for Patents   Post Office Box 7068
P.O. Box 1450   Pasadena, CA   91109-7068
Alexandria, VA 22313-1450

Commissioner:

We, Steven T. Jaffe, Kelly B. Cameron, and Christopher R. Jones, declare and state as follows:

1. We are joint inventors of the subject matter described and claimed in the above-identified application.
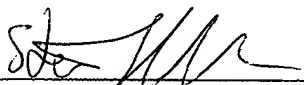
2. On or before July of 1999, we conceived the invention claimed in the above identified application. We then prepared a written description of the invention on or before September 22, 1999 and an invention disclosure describing exemplary embodiments of the invention on or before October 5, 1999. We presented the invention disclosure to our patent attorney, Mr.
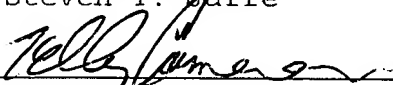
-1-

D. Bruce Prout of Christie, Parker & Hale, in a facsimile transmitted on October 11, 1999. A true and correct copy of the invention disclosure, with some of the handwritten markings redacted, is attached hereto as Exhibit A to this Declaration.

3. We worked diligently with our patent attorney to prepare a provisional patent application describing the subject matter set forth in the invention disclosure and claimed in the above identified patent application. Subsequently, on December 3, 1999, the provisional patent application was filed with the U.S. Patent and Trademark Office.

4. We declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code and such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: 1/11/06   By: _____
                            Steven T. Jaffe

Date: 1/11/06   By: _____
                            Kelly B. Cameron

Date: _____   By: _____
                            Christopher R. Jones

FS/cah
Attachments: Exhibit A

CAH PAS661273.1-*-01/11/06 12:37 PM

EXHIBIT A

BROADCOM CORPORATION

Forward to:
Dee Henderson
Intellectual Property Coordinator
Ext. 5958

DOCKET 36189

Broadcom File No. __BP1235__

Date: __10/5/99__

INVENTION DATA FORM

I.

Title of Invention __Viterbi Slicer for Turbo Codes__

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Full Name

Residence Address
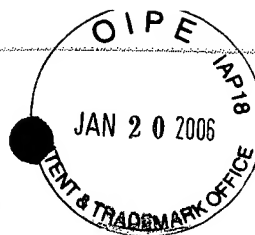
City, State, Zip

Citizenship

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__U.S.__
Citizenship

Full Name

Residence Address

City, State, Zip

Citizenship

2.   When was the invention first conceived? __7/99__

3.   (a) When were first sketches, diagrams or drawings made? __7/99 ?__
           (Append copies.)
       (b) Where are they? _____
       (c) Drawing or Notebook Ref. Nos. _____

4.   (a) When was first written description made? __9/22/99__
           (Append copy.)
       (b) Where is it? __Attached__

5.   (a) When was first explanation of invention made to others? __7/99__
       (b) Where? __?__
       (c) To whom? _____

6.   (a) When was model of invention first built? __9/99__
       (b) Where? __In Simulation @ Broadcom__

7.   (a) When was model of invention first tested or demonstrated? _____
       (b) Where? _____
       (c) Present location of model tested _____
           (Append photographs.)
       (d) Who witnessed such test or demonstration? _____

8.   Has the invention been (a) publicly disclosed; (b) placed in commercial use; (c) offered for sale or sold; or (d) described in a printed publication?   ☐ Yes   ☒ No

If "Yes," describe the first occurrence of each of (a) through (d), respectively, and give dates, places and identification.

_____

_____

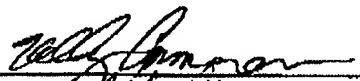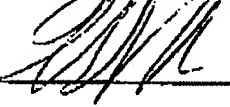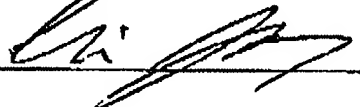If "no," are any of (a) through (d) contemplated?   ☒ Yes   ☐ No

9.   Identify known closely related publications, patents and patent applications and prior products.

_____

_____

Signature of inventors(s)

Signature		Date
(signature)	Date	10/5/99
(signature)	Date	10/5/99
(signature)	Date	10/5/99
(signature)	Date	10/8/99
	Date	
	Date	
	Date	
	Date	

On the following Invention Disclosure Sheet(s) describe the various aspects of the invention according to the following instructions:

1. **Background**: Describe the field to which invention relates, the most relevant prior art, and explain what is wrong with the prior art. Make sure to give adequate background information to enable the reader to clearly appreciate the problems that existed prior to your invention. Refer to and include relevant publications.

2. **Description of Invention**: Write a detailed description of the invention, referenced to sketches of the invention. If necessary, use additional sheets, and you may refer to separate drawings or photographs by number. The signature information at the bottom of this page must appear on each added sheet and on each separate drawing or photograph.

3. **Differences Over Prior Art**: Identify significant differences over the prior art if possible.

4. **Advantages**: List and explain the advantages of the invention in the order of their importance.

5. **Witness**: Have two individuals, not inventors and co-inventors, read, understand, sign and date each Invention Disclosure Sheet.

INVENTION DISCLOSURE SHEET

Title of Invention

Sheet_____of_____

_____   _____
Signature of Inventor   Date

_____   _____
Signature of Inventor   Date

_____   _____
Signature of Inventor   Date

_____   _____
Signature of Inventor   Date

WITNESSED AND UNDERSTOOD:

_____   _____
Witness (Not an Inventor)   10/5/99
                                     Date

_____   _____
Witness (Not an Inventor)   10/5/99
                                     Date

Parallel concatenated codes ("Turbo codes") allow communication systems to operate near the Shannon capacity. However, when operating in this region, the signal to noise ratio is very low. This low Es/No makes synchronization of the receiver difficult. The present invention helps to synchronize the receiver at this low Es/No. Receiver synchronization is often achieved via a decision directed approach. However, if the channel symbol error rate is greater than 1 in 10 (i.e., 1 out of 10 transmitted symbols is decoded incorrectly), decision directed loops can fail. "Turbo codes" operate in this region. The following invention shows how to improve this situation.

When using "turbo codes", the constituent codes are often trellis codes. Each of the constituent codes can be decoded with a conventional Viterbi decoder. (When using the iterative decoding procedure, the soft input/soft output decoding algorithm is used.).

If, instead of slicing the soft decisions at the decision point in the receiver, a sequence detector is used, decisions can be made with improved accuracy. A conventional decision directed carrier loop is shown in Figure xx. The invention replaces the slicer with a Viterbi decoder. The improved receiver is shown in Figure xx. In the case of "turbo codes", where two of more trellis codes are concatenated together, multiple Viterbi decoders are needed, all operating in parallel. In order to avoid the large delay inherent in Viterbi decoding, a limited traceback depth can be used. (In fact, the traceback depth can be set to zero.) The Viterbi decoder works on the incoming soft decisions and produces the most likely channel symbol based on past data and (depending on traceback depth) future data.

Although shown for a decision directed carrier loop, the invention is also applicable to decision directed timing loops, and decision directed AGC loops. An extension of this invention can be used for decision feedback equalization. (DFE). To extend to DFE, instead of one channel symbol being decoded, a vector of the most likely channel symbols is produced based on the internal Viterbi metrics. This vector of channel symbols is loaded in parallel into the DFE. This process is repeated for each new symbol.
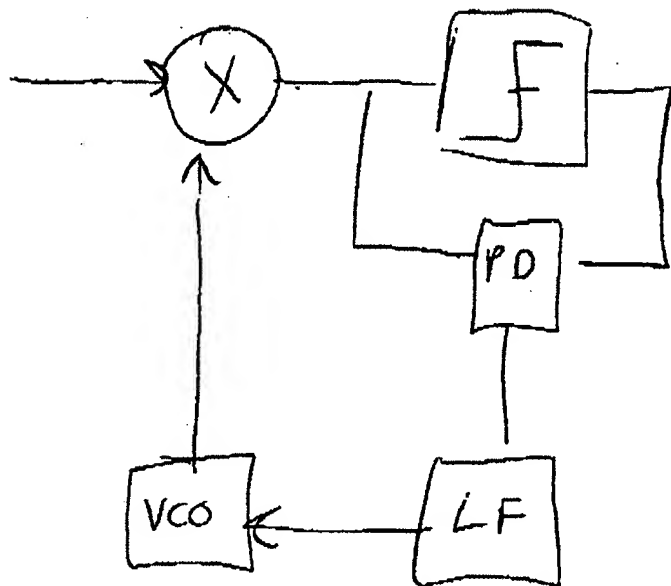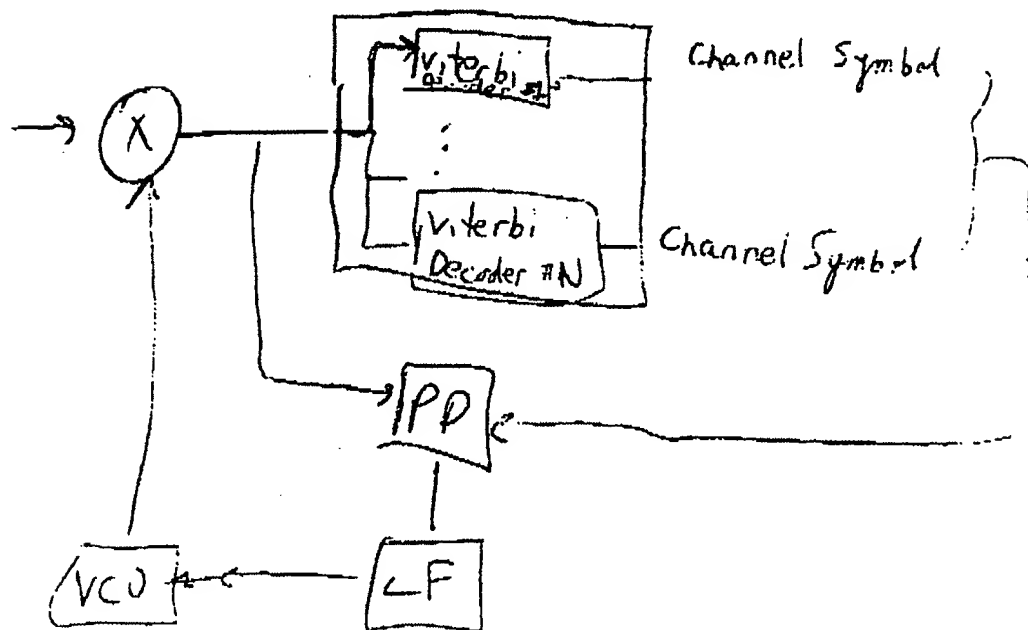
Conventional Carrier Recovery

FIG. 1

Channel Symbol

Channel Symbol

FIG. 2

Improved Carrier Loop